EFFECT OF FLUORIDE RELEASE BY BONDING AGENT AND VARNISH IN PREVENTION OF ENAMEL DECALCIFICATION DURING ORTHODONTIC TREATMENT – A COMPARITIVE STUDY

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DECLARATION BY THE CANDITATE

TITLE OF DISSERTATION	Effect of fluoride release by bonding agent and varnish in prevention of enamel decalcification during orthodontic treatment – A comparative study
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This is to certify that the dissertation entitled **"EFFECT OF FLUORIDE RELEASE BY BONDING AGENT AND VARNISH IN PREVENTION OF ENAMEL DECALCIFICATION DURING ORTHODONTIC TREATMENT" – A COMPARITIVE STUDY** by **Dr.J.Balaji** Post Graduate student (M.D.S), Orthodontics and Dentofacial Orthopaedics (Branch-V), KSR Institute of Dental Science and Research, Tiruchengode, submitted to the **Tamil Nadu Dr. M.G.R Medical University** in partial fulfilment for the M.D.S degree examination (April 2018) is a bonafide research work carried out by him under my supervision and guidance.

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TIRUCHENGODE

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Truly,

Dr. Balaji.J

INTRODUCTION

INTRODUCTION

Individuals who got long term orthodontic treatment with fixed appliances are at increased risk for white spot formation on the labial surface of banded and bonded teeth if healthy oral care regimen is not followed[1]. White spot lesions are essentially areas of porous surface enamel induced by carious demineralization and are milky white opaque spots on the smooth surface of the tooth[2]. These lesions are more common with fixed appliances because of increase in retention areas for plaque accumulation. Formation of mature dental plaque on enamel surface of teeth and fermenting dietary carbohydrates by microorganisms lead to reduction of plaque pH to a critical point, and mineral loss of enamel occurs as white spots[3,4]. This can be partially attributable to patient's inability or failure to maintain adequate oral hygiene[5]. The prevalence of white spots in orthodontic treatment has been reported to be 38% after 6 months and 46% after 12 months[6]. Presence of orthodontic attachments and arch wires complicates cleaning and makes access to plaque retaining areas difficult, especially when multiple loops, auxiliary arch wires and different types of elastics are used. The long duration of treatment and intervals between appointments create opportunities for the development of decalcification. As a result, new sites susceptible to caries will form next to the bands and brackets during orthodontic treatment with fixed appliances. There has been general agreement that the development of white spots seems to be related with the inherent resistance of the individual.

White spot lesion development is a very rapid process. Generally, the first molars, upper lateral incisors, and canines are most affected by white spot lesions. These lesions are small and restricted to thin bands surrounding the bracket bases or to areas between the bracket and the gingival margin. Lesion development may be extensive in some patients and require rapid debonding unless oral hygiene and fluoride regimens are followed accurately.

The plaque in the orthodontic patients had a resting pH lower than that of non orthodontic subjects[7]. A rapid shift in the bacterial flora of plaque after introduction of orthodontic appliances is observed. The salivary levels of S.mutants and lactobacilli are significantly elevated after insertion of orthodontic appliances. These are acidic bacteria and produce organic acids in the presence of fermentable carbohydrates. High levels of bacteria in the plaque indicate increased risk of caries development.

The most important prophylactic measure to prevent the occurrence of white spot lesions in orthodontic patients is having good oral hygiene and taking fluoride supplements. Role of fluoride is the prevention of metabolic activity of plaque bacteria, forming fluroapatite crystals, and stimulating remineralisation are some well known caries control potential of fluoride-releasing agents[8]. The various forms of fluoride products are systemic forms, gels, varnishes, toothpastes, and mouth rinses. Glass ionomer cements were initially introduced as orthodontic bonding adhesive which releases fluoride. Because of their poor bond strength their use is fairly limited. There is various fluoride releasing materials other than cements and bonding agents are commercially available to prevent the white spot lesions. These materials are DURAPHAT, FlourProtector, MI Varnish, MI Paste, NovaMin, Prevident Paste, Duraflor, GC Fuji Ortho LC etc.

Various clinical trials are going on to identify the effectiveness and efficacy of each individual product in the prevention of enamel decalcification during and after orthodontic treatment.. A study with Fuji Ortho LC showed that it reduced the lesion depth and mineral loss compared with other commercially available products[9]. Fluoride varnish like Duroflor causes less demineralization of enamel[10]. MI paste Plus helped in prevention of new white spot lesion during orthodontic treatment and decreased the number of white spot lesion already present in an individual[11].

AIM & OBJECTIVES

AIM AND OBJECTIVES OF THE STUDY

AIM:

The aim of this in vivo study is to compare the effect of fluoride release by bonding agent and varnish in prevention of enamel decalcification during orthodontic treatment. (GC Fuji Ortho LC and MI Varnish)

OBJECTIVES:

1) To compare the effect of fluoride release by bonding agent and varnish

2) To observe the amount of decalcification in each group

3) To determine the efficiency of each material in a period of time

REVIEW OF LITERATURE

REVIEW OF LITERATURE

David O.Hughes, Jonh H Henry et al[12](1979): did a study to evaluate the effectiveness of many materials that are manufactured for the prevention of decalcification of the enamel surface of teeth during orthodontic treatment He compared several polymeric adhesive coating and resinous coating materials. The teeth were divided into five groups with twenty four teeth in each group. First group received an unfilled bis GMA resin. The exposed uncoated enamel was etched with 50% phosphoric acid solution for 90 seconds then cleaned with tap water. Nuva-seal was applied after drying and polymerized with ultraviolet light. Teeth in second group received a copal resin varnish. Third group received polymeric adhesive coating. Product D was applied to fourth group. Fifth group served as control. Orthodontic bands were selected and loosely fitted with zinc phosphate cement. After setting of the cement, artificial pressure was given to loose the orthodontic band in vivo. The teeth in each group were suspended in gelatin solution. Each group of twenty four teeth was further divided into three sub groups. Each subgroup was removed from gelatin from 7 weeks, 14 weeks and 21 weeks. Orthodontic bands were removed and assessed for white spot decalcification. The result of the visual perception was recorded. The result showed that the teeth treated with unfilled Bis-GMA and polymeric adhesive coating which are acid etched material that are proved to be effective in the length of 21 weeks. Between these two acid etched material, unfilled Bis-GMA is proved to be significantly more effective in protecting against decalcification.

Leonard Gorelick, Arnold M. Geiger et al[13] (1982):did a study to find the incidence and severity of white spot lesion in orthodontically treated patients. It was a retrospective study.

Control groups included child patients from practice of two authors. Treatment group included teeth that are banded and bonded. They did direct examination, indirect slide examination of banded teeth, and direct examination of bonded canine to canine retainers. Direct clinical examination was done for debonded teeth. Indirect clinical examination was done with kodachrome slides before and after treatment. Lingual retainers are assessed using clinical inspection.. The results showed the labio gingival area of the maxillary lateral incisor has the highest incidence and were lowest in maxillary posterior segment. No white spots were found on the lingual surface of mandibular teeth. Authors suggested the need of preventive programs to reduce the degree of iatrogenic damage during orthodontic treatment and they concluded that further clinical research was needed.

Jon Artun, Bjorn O. Brobakken et al[14] (1986): conducted a study to examine the prevalence , location and distribution of carious white spots on vestibular tooth surfaces after orthodontic treatment. Two groups each comprise sixty treated individuals from two different orthodontic practices and a reference group of sixty persons who had not received orthodontic treatment. Excess material is trimmed to avoid unnecessary plaque retention areas. In both groups, simple mechanics and elastics chains are used. Prior to treatment, parents and patients required to follow organized oral hygiene programme. Carious white spot were scored from 1 to 3. The result showed higher scores for opacity and extension of lesion in group B than in reference group. No significant differences were observed between group A and reference group and between groups A and B.

Leonard Gorelick, Arnold M. Geiger et al[15] (1988) did a clinical study on preventive fluoride program was routinely used in their orthodontic office . All data were collected from two orthodontic offices in which teeth are bonded. An experimental preventive fluoride program was routinely used in that orthodontic office. The observations made from clinical study are 1. Decalcification of labial surfaces of teeth during orthodontic therapy can be significantly reduced by consistent use of 0.05% sodium fluoride rinse during treatment. 2. The incidence and severity of white spots formation are related to the length of time teeth are bracketed. This suggests the need for a preventive fluoride rinse used continuously during treatment. 3. Despite efforts to educate patient and parents, poor compliance with the preventive fluoride rinse program occurred in 50% of patients. So this suggests the need for more effective methods to change behavior pattern. 4. The one time topical application of acidulated phosphate fluoride gel immediately after bonding appears to be of little benefit in reducing the incidence of white spots.

B.Ogaard, G. Rolla et al[16] (1988) did a clinical study to investigate the effect of fluoride on caries lesion development and on lesions established during fixed orthodontic therapy. A fluoride solution with very low pH (1.9) that induced large amount of calcium fluoride was tested on lesion development underneath orthodontic bands. The study was carried out in children aged 11-14 years, in whom premolars were to be removed for therapeutic extraction. Effect of fluoride on lesion development and established lesions is assessed. Effect of debaning on established lesions is also observed. Once the study is carried out, teeth were carefully rinsed with water after extraction and stored in a humidified atmosphere in test

tubes at 4 degree C until analysis. The results showed that daily rinse with 0.2% solution of sodium fluoride retarded lesion development significantly whereas fluoride solution with low ph inhibited lesion formantion completely. The remineralizing capacity of saliva was found to be rapid in the absence of any fluoride. They emphasized on preventive measures for carious lesion development during treatment with fixed orthodontic appliance.

M. L. Adriaens, L.R. Dermaut et al[17] (1990): Did a study to determine whether Fluor Protector®, a fluoride varnish, applied to molars before orthodontic banding could prevent white spot formation. In the *in vitro* study 106 human premolars were used, divided in five different groups, representing different clinical situations. Each tooth was sliced in half, one as a control and the other as a test specimen. All tooth halves were stored in a demineralizing solution (pH4), in an attempt to induce white spot formation. The solution was renewed once a week. All buccal surfaces were inspected visually for white spot formation. In the *in vivo* study 104 molars (52 controls and 52 tests) of 28 orthodontic patients were involved. The 'split-mouth technique' was used. All patients received oral hygiene instructions. Fluor protector was applied on the buccal surfaces of the 16 and 46 before placement of orthodontic bands. Harward cement was used for banding. Visual inspection of the buccal surface of molars was done. Results showed that Fluor Protector was a good caries preventive method in site of change in parameters. The presence of band or cement only delayed the process of demineralization. It is evident that Fluor Protector® is very effective in the prevention of white spot formation under molar bands.

Leonard Gorelick, Arnold M. Geiger et al[18] (1992):did a clinical study to determine the white spot lesion and its association with daily rinse of neutral 0.05% sodium fluoride. They were adviced to use daily before bedtime. Rinsing was done immediately after brushing with fluoride containing tooth paste. Compliance was measured by recording the number of bottles used by each patient. Teeth were evaluated by visual inspection after termination of active treatment. They assessed the oral hygiene status and white spot lesion at the time of debonding. They concluded that a significant reduction in enamel white spot lesions can be achieved during orthodontic therapy through the use of a 0.05% neutral sodium fluoride rinse.

Bjorn Ogaard, Felipe Rezk-Lega et al[19] (1992):did a invivo study to investigate the cariostatic potential of a visible light curing adhesive for the bonding of orthodontic brackets and to measure the release of fluoride from the composite in water and in saliva. They used a non fluoride adhesive (Heliosit-orthodontic) and a fluoride containing adhesive (Orthodontic cement VP 862) on premolars to be extracted. The patients were allowed to use normal fluoridated toothpastes during the experimental period. The teeth were extracted after 4 weeks and stored for analysis. Microradiography was used to determine the mineral content. The fluoride release of orthodontic cement in water and saliva is observed . They concluded that the regular use of fluoride tooth paste is insufficient to inhibit lesion development. The fluoride releasing adhesive reduced lesion development significantly and no complete inhibition compared with non fluoride adhesive.

P.A.Banks, S. Richmond et al[20] (1994): did a clinical trial to evaluate the effectiveness of two new enamel sealing systems in the prevention of enamel decalcification following bracket bonding. Eighty patients undergoing fixed appliance therapy were selected and distributed into 2 groups. Group I had forty patients treated with a viscous chemically cured sealant and bonding system (Maximum cure) which was applied after etching the entire facial surface of enamel. Group II comprised forty patients treated using a non viscous visible light cure sealant and bonding agent(Trans bond resin) and the control teeth were bonded in the conventional manner using Transbond resin and paste. Enamel decalcification index was used to assess the decalcification. Scores were obtained by direct clinical observation. The results showed that 75% of patients were affected by some decalcification. The viscous sealant reduced the extent of decalcification of tooth zones by 13% and the non viscous sealant produced no significant difference. They concluded that further research is needed to develop a material which provides greater enamel protection.

L.M. Trimpeneers,L.R. Dermout et al[21] (1996):did a clinical trial to compare the effect of a visible light cured fluoride releasing(F releasing) material with a chemically cured non fluoride no-mix resin on white spot formation during fixed orthodontic therapy. 383 brackets were bonded with light cured material and 379 brackets with the chemical-cured material. Photographs were taken for the assessment of decalcification. A two way score was given (i.e., presence or absence of decalcification). The result showed that there was no significant difference between the calcification rates for both types of adhesives. No significant difference was found between the decalcification rates of upper or lower teeth and on incisors, canines, or premolars for both types of adhesives. When they evaluated white spots

in an overall manner there was significantly more decalcification in upper teeth than in lower teeth.

PE Bensen and A.A. Shah et al[22] (2005):did a study to evaluate the effectiveness of fluoride in preventing white spot lesion. They included randomized control trials or controlled clinical trials. Types of interventions they selected were topical fluoride applications (toothpaste, mouth rinse, gel and varnish) and materials containing fluoride. The review was carried out according to the standard Cochrane systematic review methodology. The databases searched were Cochrane Clinical Trial Register, MEDLINE, and EMBASE. They reviewed the available data for the presence or absence of WSL by patient at the end of treatment and quantitative assessment of enamel mineral loss or lesion depth. They concluded that some evidence proved the use of a daily 0.05% NaF mouth rinse or a GIC for bonding brackets might reduce the occurrence and severity of WSL during orthodontic treatment. More high quality, clinical trials are required into the different modes of delivering fluoride to the orthodontic patient.

Nasrin Farhadian,Amir Farhang Miresmaeili et al[23] (2008):did a in vivo study to evaluate the short term effect of single-dose application of a high concentration fluoride varnish on enamel decalcification adjacent to bonded brackets . Fifteen patients were selected who needed two premolars extracted. In each patient one premolar is considered a test tooth (Fluoride varnish) and the other was the control. Brackets were bonded to the center of tooth with no-mix composite. Patients received oral hygiene instructions and toothpaste containing

250ppm of fluoride. After a week, experimental group received fluoride varnish. T loops were inserted in the experimental teeth. The teeth were removed after 85 to 95 days and ground section was done. Microphotographs of all the regions were taken and assessed. They found that there was significant reduction in depth of demineralization in the experimental group. They concluded that the fluoride varnish can be beneficial as a preventive adjunct in reducing demineralization adjacent to brackets.

Derrick Willmot[24] (2008): in his systematic review on "white spot lesion after orthodontic treatment", he found maxillary lateral incisor and mandibular canine teeth are more prone to demineralization. The distogingival area of the labial enamel surface is the most commonly affected. There is an exponential reduction in size of white spot lesion size in first few weeks. Fluoride in high concentration should not be used as treatment as it arrests the remineralisation. White spot lesions left untreated after removal of appliance will naturally reduce in size with no intervention. Casein calcium phosphate materials and salivary stimulation by chewing gum may be effective in assisting remineralisation. For severe cases, acid micro abrasion is recommended.

Bjorn Ogaard et al[25] (2008): published article on mechanism of white spot lesion formation and fluoride prevention aspects. In their article they have concluded that Decalcifications of the enamel surface are the most important iatrogenic effect caused by fixed orthodontic therapy. The bonded attachments create the retention sites for plaque accumulation. This

creates a cariogenic environment where increased levels of S. mutans are observed after starting appliance therapy. High levels of Lactobacilli in plaque indicate increase risk of caries. Fluorides are found to be most potent inhibitor for decalcification process. There are various fluoride supplements available to inhibit the development of white spot lesions during the course of time. Patient cooperation with optimal oral hygiene and fluoride prevention is crucial for prevention. Stannous fluoride has a plaque inhibiting effect and interferes with acidogenicity of plaque. Topical fluoride in the form of solutions, varnishes, or gels is found to be feasible and safe method for fluoride application.

Christos Livas, Anne Marie et al[26](2008): did a study to investigate the use of image analysis for diagnosis and quantification of artificial white spot lesions on digital photographs before and after removal of orthodontic brackets. 20 maxillary central incisors were seleced from pool of previously selected teeth. The control teeth were photographed by one of the operator before any intervention. Brackets were bonded without any etching gel to simulate clinical situation. Demineralization was artificially induced on labial surface of 20 teeth bonded with orthodontic brackets. Digital photographs were taken at angles of 90 and 110 to labial surface. All the images were observed using image-processing software. The results showed that image analysis using digital photographs is a reproducible and accurate method. Under controlled light conditions and camera positioning, this method may be a useful tool for early diagnosis of enamel demineralization during orthodontic treatment.

Benson et al[27] (2008): Stated that accurate evaluation of demineralized white spot lesions during orthodontic treatment is important. Clinical assessment was found to be simple and inexpensive. But its validity is difficult to distinguish clinical white spots with developmental

hypoplasia or fluorosis. Photographs are the part of patient's clinical records. It can be used for assessment session and re-examined at a different time to determine reproducibility. These photographs are more versatile than a visual examination. Optical non fluorescent methods like light scattering are useful but this is technique sensitive. A laser fluorescence instrument called DIAGNODent is used. It does produce the picture of the tooth , but produces a reading which is thought to be an indication of bacterial activity, rather than mineral loss. The problem with the QLF is the size of the instrument, which limited the practical use of this technique. The method should be straight forward for the clinician to produce the reliable information regarding the effectiveness of any intervention.

Samir E. Bishara, Adam W. Ostby et al[28] (2008): Decalcification of the enamel surface adjacent to fixed orthodontic appliances is an important and prevalent iatrogenic effect of orthodontic therapy. The low pH of the plaque adjacent to orthodontic brackets hinders the remineralization process, and decalcification of enamel can occur. These lesion are subsurface enamel porosity from carious demineralization that appears as milky white opacity. Prevention of white spot lesions includes oral hygiene maintenance, dentrifices, mouth rinses, and varnishes. 0.05% sodium fluoride daily use reduces the lesion significantly. In recent times, fluoride releasing sealants was found to reduce the lesion formation. The application of topical fluoride is often considered by many clinicians as the first step in treatment. It is recommended to begin with most conservative approach to resolve the problem of white spot lesion.

Joshua A. Chapman, W. Eugene Roberts et al[29] (2010): did a retrospective study to determine the incidence and severity of white spot lesions at the time of fixed orthodontic appliance removal with routine digital photographs, and to determine whether treatment and

patient variables affect the incidence and severity of white spot lesions in patients treated with fixed appliances. Initial and final images of 332 finished cases are taken from orthodontic clinic. Photographs were assessed visually by examiner. Image J software was used to calculate the percentage of facial affected by WSLs by using direct and indirect images. The facial surface of the anterior 8 maxillary teeth was analysed. Results showed the order of incidence in lateral incisor (34%), canines (31%), premolar (28%), and central incisor. They concluded that the risk factors for the development were young age at the start of treatment, poor hygiene during treatment, unfavorable clinical outcome score, white ethnic group and inadequate oral hygiene at the initial pretreatment examination.

N. Srinivasan, M. Kavitha et al[30] (2010): did a single blinded study to assess the remineralization potential of eroded human enamel by CPP-ACP, CPP-ACP with 900 ppm fluoride and natural human saliva using surface microhardness analysis. Forty-five enamel specimens obtained from human third molar teeth were eroded in a cola drink for 8 min and then attached to intra-oral devices worn by five volunteers. One group received CPP-ACP, other group received CPP-ACP with 900 ppm fluoride and third group is the control group. Vickers microhardness test was done to establish the stages of remineralization. Results showed that both CPP-ACP and CPP-ACP with 900 ppm fluoride substantially remineralized the soften enamel, with the CPP-ACP and fluoride combination showing higher remineralization potential than CPP-ACP. They confirmed the synergistic effect of fluoride with CPP-ACP on remineralization of eroded enamel and recommended CPP-ACFP as a regular self applied coating to prevent erosive tooth wear from acidic beverages.

Eser Tufekci, Julian S. Dixon et al[31] (2011): did a study to determine the prevalence of white spot lesion in orthodontic patients at 6 and 12 months into treatment using the visual examination method. Subjects in study were recruited amoung patient who were being treated with fixed appliances in VCU Orthodontic clinic. Maxillary teeth from the right second premolar to the left second premolar were isolated with cotton rolls and air-dried for 5 seconds. Examiners assessed the tooth surface gingival to arch wire. Upon clinical examination, teeth were given a visual score based on the extent of demineralization. They concluded that a sharp increase in the number of white spot lesions during the first 6 months (38%) of treatment that continued to rise at a slower rate to 12 months (46%). They recommended the clinician to evaluate the oral hygiene status of patients during initial month and if necessary, should implement extra measures to prevent demineralization.

Emad F. Al Maaitah, Adejumoke A. Adeyemie et al[32] (2011): did a study to determine predictors for the presence and degree of demineralization during orthodontic treatment. Two hundred fifty patients who had completed their orthodontic treatment were included in the study and assessed for demineralization using light induced fluorescence (QLF) and their eligibility is determined for the effectiveness of various toothpastes at reducing demineralization during retention. Data about patients were collected from patient records. Demineralized enamel showed reduction in fluorescence with respect to surrounding sound enamel. Results showed that 65 patients had no white spot lesions and 165 had 1 to 12 according to scores. Patients with inadequate pretreatment oral hygiene developed more whie sot lesions. Patients with diseased first molars had significantly greater demineralization. They concluded that sex, pretreatment age, oral hygiene, and clinical status of the first molars

can be used as predictors for development and severity of white spot lesions during orthodontic treatment.

Michael A. Robertson, Chung How Kau et al[33] (2011): did a randomized controlled trial to determine the effectiveness of MI Paste Plus on the formation and resolution of white spot lesions in patients undergoing orthodontic treatment. Sixty patients were recruited for this study, double blinded method of randomization was used to determine whether each patient received the MI paste or a placebo paste. The paste was delivered in a prefabricated fluoride varnish tray and used once daily for 3 months. The tray was placed inside mouth for 3 to 5 minutes after brushing. Patients were reviewed every 4 weeks. Photographic records were obtained and enamel decalcification index was used to record presence or absence of white spot lesions. Results showed that the MI paste plus helped to prevent the development of new white spot lesions during orthodontic treatment and decreased the number of lesions already present. The placebo paste had no preventive action on WSLs; the number of lesion actually increased. MI paste reduced the white spots on gingival surface but the placebo paste had the opposite effect and the incisal surface effect on mean enamel decalcification index scores over time and between products was highly significant.

Blake J. Mafield, Ahmad M. Hamdan et al[34] (2012): did a study to assess the perceptions and level of awareness of patients, parents, orthodontists, and general dentists towards the development of white spot lesions during orthodontic treatment. An epidemiological survey was done to assess the perception. Results showed that all group had similar perceptions

regarding the significance, prevention, and treatment of white spot lesions. They also indicated that patients were more responsible for the prevention of white spot lesions. Communication among all groups is needed to improve to decrease the incidence of white spot lesions in orthodontic population.

Alessandra Lucchese, Enrico Gherlone et al[35] (2012): did a study to determine the prevalence of white spot lesions in patients with fixed orthodontic appliances. A cross-sectional study was done involving 191 patients. Group I had 59 patients treated orthodontically for 6 months, group II had 64 patients treated for 12 months and group 0(control) had 68 patients examined immediately before appliance placement. Lesions were evaluated by visual examination using the scoring system proposed by Gorelick. Results showed that no significant difference was observed between groups treated 6 months and 12 months. There were more white spot lesions in group I than in group II. No significant difference was found between boys and girls. Study revealed significant decalcification at 6 months after orthodontic bonding so early diagnosis is of critical importance.

Michael Knosel, Mariana Bojes et al[36] (2012): did a study to identify the susceptibility of iatrogenic white spot lesion formation after inattentive, surplus orthodontic etching with 30% phosphoric acid for either 15 0r 30 seconds with and without careful enamel brushing on the formation of cariogenic white spot lesions in a period of 6 weeks after etching and bonding. 90 permanent anterior teeth were selected for the study. The teeth were stored in isotonic sodium chloride solution with 0.1% thymol before the trial. The specimens were mounted in acrylic base plates. Teeth were randomly allocated to 6 trial groups with 15 in each group. In

each group teeth were etched with 30% phosphoric acid for 15 seconds and standardized daily enamel brushing or no brushing, etching for 30 seconds with daily brushing or no brushing, or non etched controls with brushing or no brushing. Nutritive acidic assaults were stimulated in artificial saliva for 60 minutes and the lesion depth is observed. The result showed that factors of enamel brushing, trial time elapse, and etching had a comparably significant effect on lesion progression. They concluded that excessive surplus orthodontic etching of the complete labial enamel surface, instead of bracket basis only, must be avoided to prevent iatrogenic white spot lesions. Etching times not exceeding 15 seconds are favorable.

Greg J. Huang, Brie Roloff-Chiang et al[37] (2013): A randomized control trial was done to assess the effectiveness of two agents commonly used to ameliorate white spot lesions compared with a normal home care regimen. The subjects included patients whose orthodontic appliances were removed within the past two months and had atleast one white spot lesion affecting their maxillary incisors. First group had an eight week regime of MI Paste Plus , second group has an single application of PreviDent fluoride varnish, and a control group. The lesions were assessed by two panels, 2 blinded using subjective measures, 2 examiners using objective measures and by the subject's self assessments. MI Paste Plus group received an 8-week supply at the start of study and usual oral hygiene instructions were given. Fluoride Varnish group received 0.4ml of 5% sodium fluoride varnish as a single application at the start of the study. The home care group was kept as control with nonprescription fluoride toothpaste. Photographs were taken for the assessment after 8 week. They concluded that MI Paste Plus and PreviDent fluoride varnish do not appear to be more

effective. The normal home care regimen found to improve the appearance of white spot lesions over an eight week period.

Lauren Manfred, David A. Covell et al[38] (2013): did a study to compare the bioactive glass incorporated resin with traditional resin in preventing white spot lesion. The aim of the was to evaluate the ability of BAG-bonds to inhibit superficial enamel demineralization surrounding orthodontic brackets after being exposed to an in vitro caries challenge and to test hypothesis that these novel adhesives will result in reduced demineralization. 50 extracted teeth were used and tape with a window in placed on buccal surface. These teeth were etched 37% phosphoric acid gel for 30 seconds and rinsed with water. Orthodontic brackets are bonded on these teeth using one of four novel bioactive glass(BAG)-containing orthodontic bonding agents or commercially available Transbond XD. Teeth were cycled through low pH demineralizing and physiologic pH remineralizing solutions once each day over 14 days. Knoop Micro hardness was measured on teeth 100, 200, 300 um from bracket base and 25 to 250 um from enamel surface. The results showed that BAG-Bond adhesives outperformed Transbond XT at maintaining superficial enamel hardness surrounding orthodontic brackets. Combining ideal bioactive glass into resin adhesive reduces enamel softening surrounding orthodontic brackets compared to a conventional resin adhesive.

Katie C. Julien, Peter H. Buschang et al[39] (2013): did a study to quantify the prevelence of visible white spot lesions on anterior teeth and , secondarily , to evaluate risk factors and predictors. The study included 885 patients and evaluated six anterior maxillary teeth and mandibular teeth. Digital photographs of randomly chosen patients were evaluated before and after treatment. Flurosis was evaluated based on the initial photographs due to composite

removal and subsequent enamel desiccation in the post treatment photographs. Only fluorosis on the anterior teeth was considered. The results showed that nearly 25% of the patients developed white spot lesion while in treatment, depending on fluorosis, treatment time, preexisting and oral hygiene. There were more lesions in the maxillary arch than the mandibular arch. There was no gender difference, but males had a slightly higher risk.

Hong chen, xingguuang Liu et al[40] (2013): did a systematic review to investigate which remineralizing agents are effective for the treatment of white spot lesions after orthodontic treatment. This review method is based on Cochrane oral health group's handbook for systematic reviews of interventions. The databases they searched were PubMed, Ovid MEDLINE, Web of Science and Cochrane Library. Seven articles are finally selected for the study. Three randomized control trials evaluated the effects of 3 fluoride preparations like 50-ppm sodium fluoride mouth rinse, 5% sodium fluoride varnish, and 0.5% sodium fluoride chewing sticks. The other four studies compared the effects of reminerlizing agents containing casein phosphopeptide amorphous calcium phosphate or casein phosphopeptide amorphous calcium fluoride phosphate. Two studies had a inactive control and two used a fluoride control. The method of detection also differed in each study. Authors discussed about the problems associated with the assessment methods or inadequate designs. Visual assessment by clinical or photographic examination is the most relevant approach for the assessment of white spot lesions. Both in vitro and in vivo studies showed that casein phosphopeptide amorphous calcium phosphate can promote the remineralization of subsurface enamel lesions but clinical evidence is insufficient. They concluded that reliable evidence is not available for the effectiveness of remineralizing agents for the treatment of

postorthodontic white spot lesions. They required a high quality studies with strict eligibility criteria, a combination of specific and sensitive detection methods.

Richard W. Ballard, Joseph L.Hagan et al[41] (2013): did a in vitro study to compare the esthetic outcomes of white spot lesions treated with three commercially available products that have been reported to have a positive effect on the remineralization of the enamel. Forty extracted premolars with obvious decalcifications or obvious caries. All samples were exposed to a demineralization solution at 37˚Cfor 14 days to produce a white spot lesion. Group 1 samples are kept as control group, group 2 samples are treated with Novamin tooth paste, grou 3 samples are treated with Prevident 5000 paste and group 4 samples are treated with MI Paste Plus. All groups were evaluated 5 times like pretreatment, immediately after demineralization, day 7 of treatment, day 14 of treatment, day 21 of treatment, and day 28 of treatment. The teeth were photographed in a light-controlled environment using a standardized camera (Nikon) and setting with a 60 mm/AF micro lens. The photographs were evaluated by 5 member panel of nondental personnel and 5 member panel of dental personnel. The results showed that the subjective and objective results were mixed within groups and between groups for the products tested. They found no conclusive evidence that any of these 3 commercially available materials produce more favorable esthetic white spot lesion remineralization results. Further study with different delivary methods, remineralization periods, and evaluation methods would complement the results of this study.

Mehmet Akin, Mucella Tazcan et al[42] (2013): did a study to investigate the incidence of white spot lesion during fixed orthodontic therapy and to determine the significant factors. One hundred fifty-six patient records were randomly selected by using random number from patients treated in the orthodontic clinic at the university of Selcuk. The groups were seperated by date of birth, gender, treatment beginning date, treatment period and hygiene score were determined. White spot lesion scoring was done from first molar to other first molar for both jaws. Routine clinical photographs were collected and observed for lesion development. Modified scoring system introduced by Gorelick was used for the visual examination. Results showed that using a standardized general photographic records, high incidence of newly develoed white spot lesions in patients treated with comprehensive fixed orthodontic therapy. Gender and treatment length were not associated with white spot lesion development a significant was evidenced with age at start of treatment and oral hygiene.

Jubin Easo Jose, Sridevi Padmanabhan et al[43] (2013): did a study to evaluate and compare the effects of the systemic consumption of probiotic curd and the topical application of probiotic toothpaste on the Streptococcus mutans levels in the plaque of orthodontic patients. The study was double blinded and randomized containing 60 patients undergoing orthodontic treatment. They were divided into 3 groups of 20 each. Group 1 consists on control group. Group 2 were given 200mg of probiotic curd and instructed to eat it with their lunch for 30 days and brush twice daily with regular fluoride toothpaste. Patients in group 3 were asked to brush with probotic toothpaste only for 30 days and to discontinue using their normal toothpaste. Samples were collected before the study and after 30 days. The ultrapure genomic DNA Spin Miniprep kit was used for fast isolation of genomic DNA. Real time polymerase chain reaction was done using SYBR green assay for relative quantification of the bacteria in

the samples. Results showed that the group 2 and 3 were statistically significant compared with group 1. The Consumption of of probiotic curd and toothpaste cause significant decrease in S.mutans levels in the plaque around brackets in orthodontic patients. Authors suggest long term evaluation to assess advantages of probiotics in orthodontic patients.

Jay Bowman, Adilson Luiz Ramos et al[44] (2013): did a in vivo study to examine the effectiveness of fluoride varnish in reducing enamel demineralization. They evaluated 10 consecutive patients who sought orthodontic treatment. A crossover design was used in this study. One pair of crossed quadrants of each patients mouth were designated at random as the experimental group and the contralateral quadrants assigned as the control group. A sample of 200 teeth with 100 in the experimental group and 100 controls. Photographs were taken prior to the orthodontic treatment. After bonding of brackets, fluoride varnish was applied for the first of 4 applications during the experimental period of 1 year. A thin coat of Duraflor varnish was applied with a microbrsuh to the dry enamel around the orthodontic appliance. Varnish applications were repeated every 3 months to the experimental quadrants of each patient over the first year of orthodontic treatment. At each application new set of digital photographs were taken. Examiners performed a double-blinded examination of the phographs. White spot lesion is registered using Banks and Richmond method. Results showed that a 44.3% reduction in the mean enamel demineralization index was found for teeth that had been treated with fluoride varnish, compared to controls.

Hussan Milly, Frederic Festy et al[45] (2014):did a study to evaluate the potential of bio-active glass(BAG) powder and BAG containing poly acrylic acid(PAA-BAG) to remineralize

enamel white spot lesion. Melted dental wax was applied to protect part of enamel leaving an exposed window for creating artificial lesion. Lesions were created using 8% methylcellulose gel buffered with lactic acid layer. For 14 days at 37 C. teeth with artificial lesion were assigned to 4 experimental groups (a) BAG slurry, (b) PAA-BAG slurry, (c) Standard remineralization solution and (d) de-ionized water. Raman spectroscopy was used to scan lesion cross section. Another 20 samples were used to assess the sound enamel reference level and it was scanned using scanning electron microscopy. The results showed that BAG and PAA-BAG surface treatments enhance white spot lesion remineralization assessed by the resultant improved mechanical properties, higher phosphate contents and morphological changes within the artificial lesions. Smaller particle precipitations were detected within PAA-BAG compared to the BAG, this has a potential to promote entire mineral gain of treated lesions.

Su-Yeon Jo, Hyun-jeong Chong et al[46] (2014): did a in vitro study to examine the effects of fluoridated, casein phosphopeptide-amorphous calcium phosphate complex (CPP-ACP)-containing, and functionalized ß-tricalcium phosphate(fTCP)-containing toothpastes on remineralizationon white spot lesions by using quantitative light induced fluorescence Biluminator. Forty-eight premolars extracted for orthodontic reasons from 12 patients were used as specimens. Group 1 was a control group, group 2 was treated with 1000-ppm fluoride containing tooth pastes. Group 3 were treated with CPP-ACP containing tooth pastes and group 4 was treated with fTCP-containing tooth pastes. The specimen was prepared to create an artificial environment. The enamel surface was painted with acid resistant nail varnish except for a window at the center of the buccal surface , to prevent contact with the demineralizing and remineralizing agents. Each tooth was soaked in demineralizing solution

at 37˚C for 996 hours to create White spot lesions. Light induced fluorescence images were captured by using an intraoral fluorescence camera and images are examined with analyzing software. The results showed that fTCP and CPP-ACP containing toothpastes seem to be more effective in reducing white spot lesions than 1000-ppm fluoride-containing toothpastes.

Gustavo M.S.Oliverira, Andre V. Ritter et al[47] (2014) : did a invitro study to compare the remineralizing effect on white spot lesions of casein phosphopeptide-amorphous calcium phosphate crème, or CPP-ACP (MI Paste™),1.1% NaF dentrifice containing 5000 ppm of fluoride (Control RX™), or CPP-ACP crème with 900 ppm of fluoride (MI Paste Plus™) with that of control. Thirty five extracted human third molars were collected for the study and splitting each tooth in four sections of approximately equal size, and providing a total of 140 enamel slabs. The enamel surfaces are protected with polyvinyl siloxane material. The demineralization is created using solution at 37˚C for 8 weeks, and visually examined for the formation and surface integrity of the new formed caries like lesions. Group 1 control group received no treatment, Group 2 treated with MI Paste, group 3 with F5000 and group 4 treated with MI Paste Plus. The applications were performed once in the morning and again in the evening. The products were applied in the form of slurry, formed by one part of product and three parts of artificial saliva, directly over the lesions as previously published. The results showed that a 1.1% NaF dentrifice (5000 ppm) demonstrated greater remineralization ability than the CPP-ACP topical tooth crème and that the addition of fluoride to its formulation seems to enhance remineralization. They found saliva also has the ability to exert an important remineralization effect over time.

Derek A. Hoffman, Andrew E.Clark et al[48] (2015): did a in vivo study to determine if the use of Novamin reduces the formation of white spot lesions and improves gingival health in orthodontic patients. This was a prospective, double blinded, randomized clinical trial. A total of 48 patients were into the study and grouped into two. The control group encompassed 24 patients who received commercial toothpaste containing 0.15% fluoride (Crest®, Procter and Gamble, Cincinnati, OH). The experimental group consisted of 24 patients who received toothpaste containing NovaMin. At 3 months and 6 month interval pictures were taken for the assessment of decalcification. Decalcification is assessed by modified version of the white spot lesion index. Gingivitis is measured using gingival index. Measurement of plaque was done using Turesky modification of the Quigley-Hein index. Results showed that there is no significant difference between an over the counter fluoride containing toothpaste (Crest®) versus a toothpaste containing NovaMin (ReNew®) in their ability to improve white spot lesions, plaque levels, and gingival health in orthodontic patients.

Mikael Soesson, Fredrik Bergstrand et al[49] (2016): did a systematic review to evaluate the current evidence of effectiveness for clinical methods using remineralizing agents or minimal invasive techniques to manage post-orthodontic white spot leions, based on primary clinical trials. Cases were selected with white spot lesion registered and scored within 3 months after debonding of fixed appliance. They accepted any type of intervention except laminate veneers to reverse the post orthodontic white spot lesion. Outcomes were assessed by visual clinical scores, photographs, caries detection devices or patient/therapist satisfication. Four databases were searched for controlled clinical trials and Cochrane handbook and the AMSTAR tool were used for grading the risk of bias. They concluded that there is a lack of reliable scientific evidence to support remineralizing or camouflaging strategies to manage

post-orthodontic white spot lesion. Daily use of fluoride toothpaste must be considered as best clinical practice, further well-performed controlled clinical trials with long-term follow-up are needed to establish best clinical practice.

Fernandes, Fabricio Eneas et al[50] (2016): did a systematic review of clinical trials that have investigated the effects of fluoride materisals used to bond bracets or applied close to the bonding interface on the development and progression of white spot lesions. This was conducted following the PRISMA statement. The studies included the clinical trials and comparision of dental materials containing fluoride and non fluoride materials. A MEDLINE search was conducted, followed by meta-analysis comparing the results. The Cochrane Risk of Bias Tool was used to assess the study methodology quality. Review suggested that the fluoride releasing materials can reduce the risk of white spot lesions development when used to cover or cement orthodontic brackets. Materials such as sealants and varnish presented increased solubility in oral environment. When white spot lesions had already occurred, there is no evidence that fluoride-releasing materials reduce the extent of these lesions.

Damian Hochli, Monika Hersberger-Zurfluh et al[51] (2016): did a systematic review and meta analysis to critically assess the evidence from randomized clinical trials on humans investigating interventions to treat WSLs that originated from fixed orthodontic therapy. They included parallel study or split-mouth RCTs on human patients comparing any intervention. An unrestricted electronic search of eight databases was done and they selected only randomized control trials. The risk of bias was assessed by Cochrane's risk of bias tool. They concluded based on existing trials that interventions for post-orthodontic white spot

lesion mainly fluoride varnish or 5 % sodium fluoride film seem to be effective than daily tooth brushing with a fluoride dentifrice. But research is needed to elucidate their clinical relevance.

Mattew D. Brown, Phillip M. Campbell et al[52] (2016): did a practice-based research approach to evaluate white spot lesions among treated orthodontic patients. This study was done in Texas A&M University. A PBRN would make it possible to determine more efficiently and effectively that which patients are at greater risk of developing white spot lesions. Forty seven alumini were qualified to participate in the study and final sample size included 158 patient. Photographs were used to assess the decalcification. Scoring was given according to modified Ogaard score. Results showed that patients with caries risk developed more lesions than patients without risk factors. The risk factor that proved to be significant is sugar exposure. Longer treatment duration was also found to be risk factor. Orthodontic patients treated in private practice were found to have more white spot lesion than treated in an institution. Patients at greatest risk can be identified prior to treatment based on ADA Caries Risk Assessment, oral hygiene, and gingival health.

Federico Perrini, Luca Lombardo et al[53] (2016): did a study in vivo to evaluate the efficacy of Duraphat a fluoride varnish in preventing white spot onset over a longer period, 12 months, in patients with fixed appliances with the help of laser fluorescence. 24 patients were included in the study, undergoing orthodontic treatment at a private dental clinic. A split mouth study was designed, applying the varnish to quadrant 1 and 3, with quadrants 2 and 4 as untreated controls. Measurements were taken at 4 sites using a DIAGNOdent Pen 2190

laser (655nm).results showed that there was no statistically significant difference in the demineralization between treated and untreated teeth. The periodic application of fluoride varnish can offer some protection against white spots, but not to a significant degree in the course of time.

MATERIALS & METHODS

MATERIALS AND METHODS

MATERIALS

MI Varnish (fig 1)

Topical fluoride with calcium and phosphate

Each unit contains 0.55g (0.5ml)

GC Fuji Ortho LC (fig 2)

It is a light cured orthodontic bonding adhesive

It is available as power and liquid system

Bonding materials used (fig 3)

Etchant - 34 % phosphoric acid solution(Scotchbond – 3M ESPE)

Primer -Transbond XT –3 M Unitek

Inclusion criteria:

Complete permanent dentition

No caries or fillings in the anterior teeth

No hypocalcified teeth

No dental fluorosis

Who had not extensively used fluoride regimens

Exclusion criteria:

With any medical condition and not allergic to any of the materials used

Already undergone orthodontic treatment

Currently using any investigational drug

Patient selection:

Each patient is randomly allocated into two groups. It is a blinded study. 10 patients in each group are allotted. Six maxillary anterior teeth are selected for assessment of decalcification and total of 60 teeth were engaged in the study in each group. Totally 120 teeth are evaluated for white spot lesions. One group received MI Varnish after bonding with non fluoride releasing bonding agent and other group received GC Fuji Ortho LC.

Methods

All patients who required treatment for various malocclusions are selected and grouped into two. Both the groups received preadjusted edgewise appliance with MBT prescription and a standard mesh brackets were used (American Orthodontics). Only simple mechanics and E chains are used with straight wires, no auxiliary wires or springs are used during the course of the study

Group I:

After pumicing each teeth in maxillary arch from right canine to left canine, etching is done with 37% phosphoric acid (Scotchbond – 3M ESPE) for 20 seconds and primer (Transbond XT) is applied and cured. Brackets in each tooth are bonded using Transbond XT and light cured. After isolation MI Varnish (fig 4) is applied over the labial surface of six maxillary anterior teeth and allowed to dry for 1 minute. A thin layer of coating is formed

over tooth when contact with saliva. Patient is instructed to follow good oral hygiene measures. They are checked for excellent oral hygiene maintenance at every month interval to eliminate bias in the study. Application of MI Varnish is repeated for every 3 months and photographs are taken at the end of 10 months.

Group II:

After pumicing each teeth in maxillary arch from right canine to left canine, etching is done with 37% phosphoric acid (Scotchbond – 3m ESPE) for 20 seconds and primer (Transbond XT) is applied and cured. Brackets are bonded using GC Fuji OrthoLC, which is a fluoride releasing bonding agent (fig 5). It is used as per instructions of the manufacturer. Oral hygiene instructions are given for patient and routinely checked for plaque accumulation. This eliminates bias in the study. Photographs are taken at the end of 10 months to observe the area surrounding the brackets for white spot lesion formation.

Photographs:

Photographs are taken using canon 700D with 18-55 lens and ring flash (Macro Ring Lite) attached to it (fig 6). The shutter speed (1/30), focal length (1/10) and ISO adjusted according to natural light are controlled in the manual mode. All photographs were taken perpendicular to the tooth surface, to provide accurate assessment of the possible decalcifications. The raw images are converted into jpeg images and worksheets are made for each patient in each group (fig). The images of two groups are color coded since it is a blinded study. The slides prepared for each group were evaluated by five observers. These

observers are well qualified orthodontists who evaluate the amount of decalcification based on enamel decalcification index.

The scores are,

Score 0 – no decalcification

Score 1 - mild, but clinically visible decalcification < 50% of the area

Score 2 - moderate to severe decalcification, >50% of the area

Score 3 - decalcification covering whole area, surface breakdown or caries

Fig 1 MI Varnish

Fig 2 GC Fuji Ortho LC Bonding Adhesive

Fig 3 Bonding Materials

Fig 4 Group I Materials

Fig 5 Group II materials

Fig 6

Camera Canon 700D with Macro Ring Lite Ring Flash

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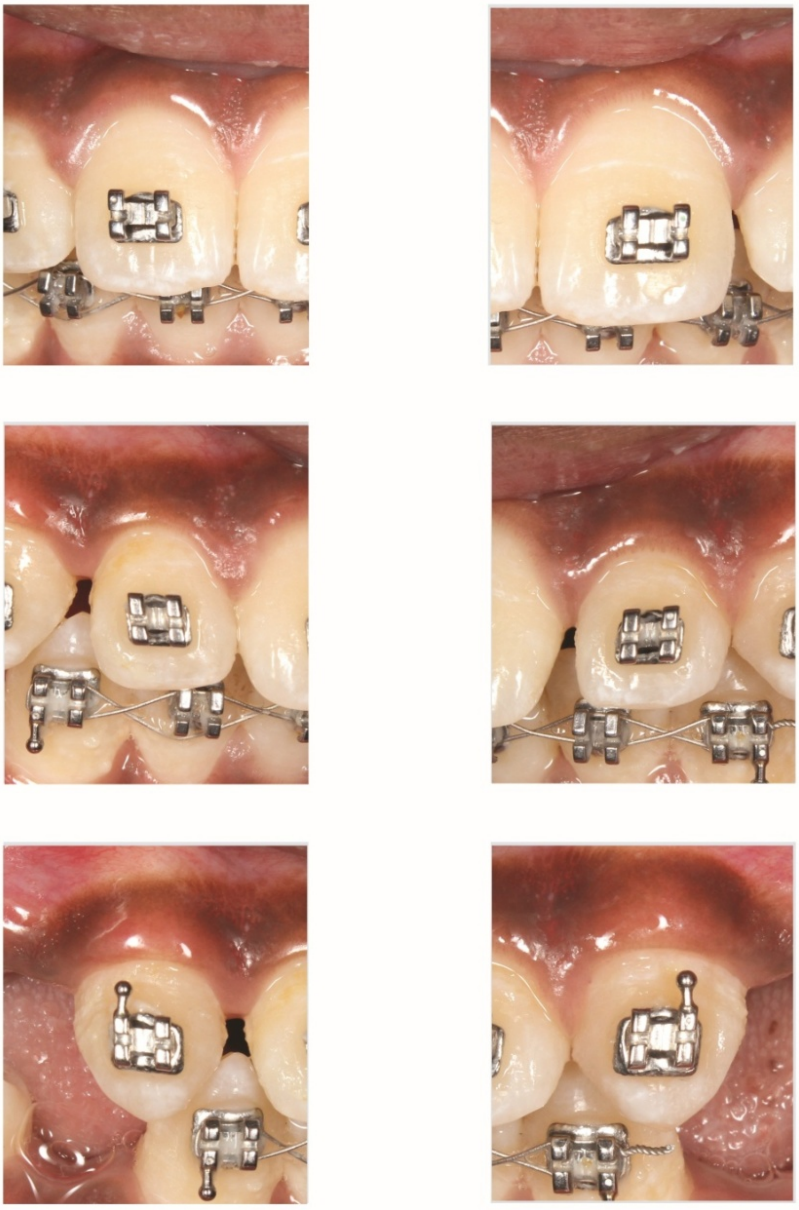

fig 7

An example og Group I image

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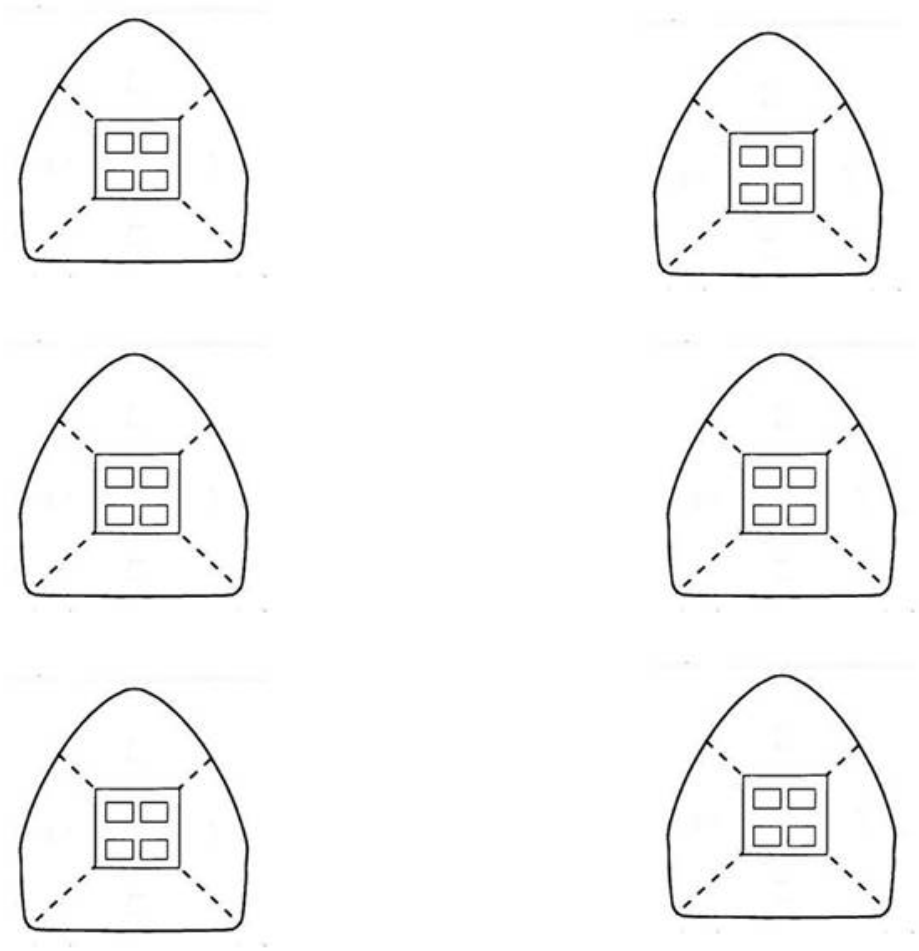
fig 8

An example of Group II image

A proforma is made for the assessment of decalcification in each tooth.

Fig 9

ENAMEL DECALCIFICATION INDEX



0 = no decalcification

1 = mild, but clinically visible decalcification < 50% of the area

2 = moderate to severe decalcification , >50% of the area

3 = decalcification covering whole area, surface breakdown or carles

RESULTS

RESULTS

DEMOGRAPHIC DETAILS:

The present study was carried out among patients in KSR Institute of dental science and research, to evaluate the effects of fluoride release by bonding agent and varnish with non fluoride releasing adhesive in prevention of enamel decalcification during orthodontic treatment. This study was done among 20 patients for a period of 10 months who fulfilled the inclusion and exclusion criteria. The patients were given two interventions; MI Varnish (Group A) and GC Fuji Ortho LC (Group B).

AGE:

The mean age of the patient in group A was 16 (± 2) years and group B was 17.6 (±5) years. . No statistically significant difference was observed between the groups based on age denoting that the participants were distributed equally in both the groups. (P value >0.05)

RESULTS:

Table 1: Distribution based on decalcification index for mesial surface at post intervention examination among group 1 and group 2

GROUP	**PERCENTAGE OF DECALCIFICATION**	**P VALUE**
GROUP I	47%	0.004*
GROUP II	22%	

*Mann Whitney test <0.05=statistically significant

Inference: Table 1 shows the amount of decalcification in mesial side is more in group I than in group II. There is statistically significant difference between two groups were observed.

Table 2: Distribution based on calcification index for distal surface at post intervention examination among group 1 and group 2

GROUP	**PERCENTAGE OF CALCIFICATION**	**P VALUE**
GROUP I	45%	0.022*
GROUP II	25%	

*Mann Whitney test <0.05=statistically significant

Inference: Table 2 shows the amount of decalcification in distal side is more in group I than in group II. There is statistically significant difference between two groups were observed.

Table 3: Distribution based on decalcification index for gingival surface at post intervention examination among group 1 and group 2

GROUP	**PERCENTAGE OF CALCIFICATION**	**P VALUE**
GROUP I	43%	0.088
GROUP II	28%	

*Mann Whitney test <0.05=statistically significant

Inference: Table 3 shows the amount of decalcification in gingival side is more in group I than in group II. There is statistically significant difference between two groups were observed.

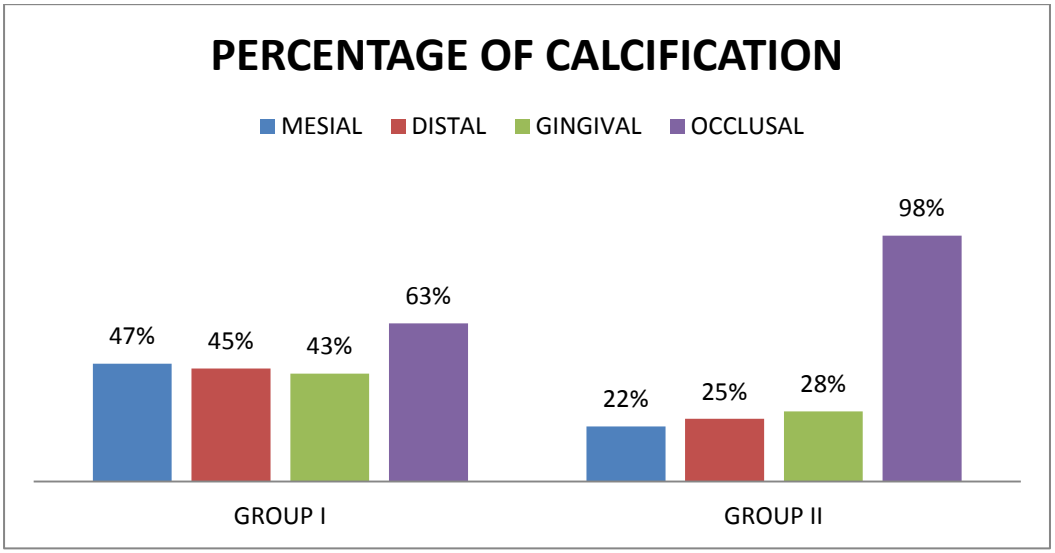
Table 4: Distribution based on decalcification index for occlusal surface at post intervention examination among group 1 and group 2

GROUP	PERCENTAGE OF CALCIFICATION	P VALUE
GROUP I	63%	0.00
GROUP II	98%	

*Mann Whitney test <0.05=statistically significant

Inference: table 4 shows the amount of decalcification in occlusal side is more in group I than in group II. There is statistically significant difference between two groups were observed.

Bar diagram showing the overall percentage of decalcification in each group at different sides of tooth



DISCUSSION

DISCUSSION

Orthodontics significantly improves the patients who at the end leave the orthodontic office with corrected malocclusion, well aligned teeth a boost in self-confidence and overall sense of well being. In this esthetically driven profession, white spot lesion is a negative outcome of the treatment. This occurrence of lesion is unfortunate for a profession that focuses on the esthetic of the face and teeth, especially since these lesions mainly occur in the maxillary anterior dental region[54]. It is seen as a tooth discoloration around the bonded attachment area during and after the orthodontic treatment. By definition these are subsurface enamel porosity from carious demineralization that presents itself as a milky white opacity when located on smooth surface[55].

In general orthodontic patients have significantly more decalcification than non orthodontic patients which later becomes an esthetic problem[56]. A group of patients who undergo orthodontic treatment generally have poor oral hygiene. Indeed, poor oral hygiene of these patients can only be negatively compounded by the presence of brackets, arch wires, ligatures, and other orthodontic appliances which make maintaining proper oral hygiene even more difficult. These attachments increase the surface area for plaque retention and ultimately cause demineralization around brackets in four weeks time, put the patient in an increased risk. There is a rapid shift in the composition of bacterial flora of the plaque following the introduction of fixed appliances. More specifically, the levels of acidogenic bacteria, such as S. mutans, significantly elevated in orthodontic patients. When S. mutans and Lactobacilli are combined with fermentable carbohydrates such as glucose, fructose, or sucrose, lactic acid is produced resulting in a rapid decrease in the intraoral pH, specifically below 5.5, creating an acidic environment favorable for initiating enamel decalcification[57]. This intra oral pH rebounds after 30-60 min due to the body's natural buffering capacity but by then enough time has occurred for the decay process to begin. This change is pH is due to

certain factors such as bacteria, fermentable carbohydrates and tooth surface[58]. Proteins from food create a biofilm on the tooth surface which becomes colonized by bacteria[59]. The lesions once formed appear to be surface demineralization rather than a subsurface lesion with an intact surface zone. Remineralization of these white lesions is a natural phenomenon resulting in the partial reversal of early carious lesion. The mineral of the dental enamel is in equilibrium with oral environment and saliva contains all the necessary elements for hydroxyl crystal growth. In the natural process, there is demineralization and remineralization continually taking place. Remineralization varies considerably from subject to subject and from site to site in the mouth. Sometimes the amount of remineralization cannot totally overcome the amount of demineralization even with natural process. This problem is encountered with most of the patients with fixed orthodontic therapy. In such a situation an additional preventive agents must be used to enhance reminalizing process.

ROLE OF FLUORIDES

Fluoride is a widely recognized remineralizing agent interacting with oral fluids on the on enamel surface and subsurface, and combining with calcium and phosphate ions to form carbonate substituted hydroxyapatite and fluoroapatite[60]. When fluorides are used excess they cause dental fluorosis and can be toxic if administered in high enough doses. Fluorides exhibit a inhibiting effect on tooth demineralization and an enhancing effect on remineralization. When fluorides applied topically, a calcium fluoride like material builds up in plaque, on the tooth surface (enamel/dentin), or in incipient lesions. The calcium fluoride acts as a reservoir of fluoride ions for release when pH is lowered during a caries attack[56]. The dissolution rate of calcium fluoride at different pH is controlled by phosphate and proteins[61]. Small lesions can be remineralized with low fluoride preparations[62]. To avoid, arresting the lesion and obtunding the surface layer, low dose of fluoride application like 50

ppm fluoride rinse had a higher efficiency for remineralization than a control solution or a regular mouth rinse containing 250 ppm[62].

ROLE OF VARIOUS FLUORIDE SUPPLEMENTS

The most important prophylactic measure to prevent the occurrence of white spot lesion in orthodontic patients is implementing a good oral hygiene and taking fluoride supplements. There are lots of fluorides releasing supplements that can be used as remineralizing agents for the treatment. Fluoride toothpaste is the basis for all caries prevention and preventive method for white spot lesion. Most toothpaste contains sodium fluoride, monofluorophosphate, stannous fluoride, or amide fluoride. A dose response effect of fluoride in toothpastes has been demonstrated, and fluoride concentration below 0.1% should not be recommended for orthodontic patients. The cariostatic effect will improve significantly if oral hygiene is also improved.

FLUORIDE VARNISHES

In 2001 Ogaard and Larsson found that the use of either fluoride or chlorhexidine varnishes in combination or using a fluoride varnish alone resulted in a 30% reduction in white spot lesions at the time of debonding when compared with control group that did not receive any varnish application during treatment. They also emphasized that combination regimen did not result in significantly less white spot lesion than application of fluoride varnish alone. The patients lacking motivation for maintaining oral hygiene is a challenge to the clinician in spite of using fluoride regimens and antimicrobial agents.

Mandershah and Ganesh in 2013 compared and evaluated the effects of conventional versus light cured fluoride varnish on prevention of enamel decalcification. They compared ClinproTM XT (LCFV) and Duraphat (conventional fluoride varnish). Since it is a histologic

study, role of varnish could be assessed only for four months. They concluded that single application of LCFV (Clinpro TM XT) can prevent enamel demineralization for longer duration (for up to 4 months) of time as compared to conventional fluoride varnish (Duraphat TM, 45 days) during fixed appliance therapy. Didem and mehmet in 2013 did a invivo study between two commercially available fluoride varnishes (Duraflor and Enamel Pro).after extracting the premolars, decalcification is evaluated quantitativelyby cross sectional microhardness testing at depth of 100 and 200 um. The results showed that Enamel Pro® Varnish and Duraflor™ group values are higher than the values of control group at every depth. The differences between the depths showed that the microhardness values decreased significantly when the depth increased. In the control group, more demineralization occurred in every indentation compared to the study group. They concluded that Duraflor™ and Enamel Pro® Varnish can be considered for use in clinic as an effective method to prevent or reduce demineralization during orthodontic treatment, especially in patients with poor oral hygiene. Perrini and Lombardo in 2016 did a in vivo split mouth study to evaluate the efficiency of DuraphatTM varnish in prevention of enamel decalcification. The frequency of application is differed in each groups and degree of lesion development is measured using DIAGNOdent pen 2190 laser. They concluded that periodic application of fluoride varnish can offer some protection against white spots, but not to a statistically significant degree if the patients have excellent oral hygiene.

FLUORIDE RELEASING ADHESIVES

Initially as a part of preventing caries, resin-modified glass ionomer (RMGI) cements were used. There have also been attempts at using fluoride containing glass ionomer adhesives to bond orthodontic brackets. Ekaterini and Thomas in 2009 did a in vitro study to evaluate the efficiency of five different bonding materials. The materials are Transbond SEP, Proseal with Transbond XT, Clearfill Protect Bond with Transbond XT and GC Fuji Ortho

LC. They scanned the demineralization with cone beam microtomograhic system and polarized light microscopy. After evaluating by both the method, Fuji Ortho LC showed a significantly smaller lesion depth and less mineral loss when compared with other materials.

Basdra and Huber in 1996 did an in vitro study to examine the fluoride release between two orthodontic agents. They compared the Rely-a-Bond and Fluorobond for the inhibition of enamel demineralization. Scanning electron microscopy was done on enamel and found that a deposition of calcium fluoride is observed. Calcium fluoride found to have a cariostatic effect. They concluded that certain fluoride releasing orthodontic bonding system may provide an additional degree of safety against caries susceptibility in patients with fixed appliance for a limited period.

EVALUATION OF WHITE SPOT LESION

Accurate evaluation is also important for the research workers to assess new products or interventions, which might help prevent the appearance of demineralized lesion during treatment. This is because, by early detection of enamel lesion we can advice patients regarding changes in oral hygiene and diet, as well as implement suitable preventive measures. From past there are lot of evaluation methods that has been followed to identify the white spot lesion. Irrespective of any method used, it should fulfill basic criteria like validity, reproducibility and ease of use[27]. A basic method for the identification of lesion is clinical examination. In this method we can train the clinician to assess the presence of demineralization and various studies have been reported by using visual examination method before during and after orthodontic treatment[63,64,65,66]. It is simple, inexpensive and clinically valid. Demineralization leads to more scattering of the light entering enamel. This sideward scattering of light is assessed using Optical Caries Monitor[67,68]. This method has been used in only one study[69]. Demineralization leads to more backscatter of light, hence less absorption

and a lower intensity of fluorescence. Carious enamel will therefore show up as a dark area with fluorescent techniques. Various fluorescent and non fluorescent dyes have been used to highlight carious enamel[70]. Lasers are used in method of assessing in recent times, an instrument called DIAGNODent. It is a portable system, which emits light of wavelength 655 nm or the red end of the electromagnetic spectrum. It does not produce a picture of the tooth, but produces a reading, which is thought to be an indication of bacterial activity, rather than mineral loss[71,72]. The problem with the laser system is the size of the apparatus, which limited its use. A smaller portable system for intraoral use has been developed with a new light source and filter system, Quantitative Light Induced Fluorescence or QLF[73]. QLF has been shown in the laboratory to be a useful technique that may be applied to orthodontic patients[74].

In many studies photographic techniques have been used extensively to study the prevalence of enamel opacities. Many orthodontists now routinely take photographs as part of a patient's clinical record. This method can be carried out quickly and efficiently in most of the time. This method can be standardized so that clinical variability of the diagnostic conditions may be minimized. It provides a permanent record and can therefore used in repeated assessment session at a different time to determine reproducibility. It is easy to mask patient details so they can be examined in a random order to reduce the bias. These photographs are more versatile than a visual examination. They can be assessed several trained judges to obtain a consensus. They can also be digitized and a computer used to measure the severity of the lesion in terms of area or change in whiteness or grey levels[75]. In this study also we used photographs for the assessment of white spot lesion. Five qualified orthodontist scored these lesions using printed photographs and an average of the score was taken. More trained observers are used to reduce the risk of bias. The scoring was based on enamel decalcification index.

In our study we used MI Varnish (Group I) which is manufactured by Recaldent for the prevention of enamel decalcification. There are no previous studies about their efficiency in orthodontic patients. We applied MI Varnish every three months and results is observed at the end of ten months. Once it is applied it forms a thin layer when contacted with saliva and the patient is advised not to have any food for 2-3 hours specially foods having coloring agents. High release of fluoride occurs during that time and formation of fluoroapatite crystals takes place. When the examiners observed the enamel decalcification using index, the average score was 1. This indicated that only mild decalcification has occurred when using MI Varnish with non fluoride releasing adhesive. This proved the effectiveness of the material in reducing the amount of decalcification. This is due to sudden release of high fluoride at the initial appointment and reduces gradually and decreases to zero after some time. Some studies stated that sudden release of high fluoride also have an inhibitory effect on prevention of lesion development.

In group II we used a fluoride releasing adhesive GC Fuji Ortho LC, which is light cured adhesive available in powder and liquid form. Once the brackets are bonded with adhesive, no interventions are carried out during the period of 10 months. Photographic records are taken and scored by observers. The results showed that average amount of decalcification were only mild with the score of 1. The mechanism behind the use of composite is, there will be slow and constant release of fluoride over long period of time in contrast to varnish. A statistical test was done to find the effects and efficiency between these two commercially available materials. Mann whitney test showed that amount of decalcification in mesial side was more in group I than in group II. On distal side, more lesion development is observed in group I than in group II. In gingival region, more lesion development has occurred in group I than in grou II. But in incisal region, the amount of

decalcification was more in grou II than in group I. The bar diagram showed that the overall amount of mild decalcification was more in group I than in group II.

This study clearly showed that use of fluorides reduces the amount of decalcification and has an inhibitory effect in lesion development. The results of the study proved that both these commercially available fluoride releasing materials (MI Varnish and GC Fuji Ortho LC) has an inhibitory effect on lesion development. But the significant reduction in amount of lesion development was found to be reduced in GC Fuji Ortho LC than MI Varnish group.

SUMMARY & CONCLUSION

SUMMARY AND CONCLUSION

SUMMARY

This study compared and evaluated the effect of fluoride release by bonding agent and varnish in prevention of enamel decalcification during orthodontic treatment. We compared the MI Varnish and GC Fuji Ortho LC adhesive composite for fluoride release in prevention of white spot lesions. The extent of the lesion is observed using photographs by well qualified orthodontists based on enamel decalcification index. The scores denote the extent of lesion after orthodontic treatment. This study showed the efficiency and effectiveness of each material individually in prevention of white spot lesion in a span of ten months.

CONCLUSION

- The significant reduction in development of lesion is much reduced with GC Fuji Ortho LC group than MI Varnish group.

- Fluoride release from bonding adhesive (GC Fuji Ortho LC group) gives better result than varnish with non fluoride adhesive (MI Varnish group).

- It is easy to use fluoride releasing adhesive over fluoride releasing varnish and reducing the clinician’s compliance.

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ANNEXURE

ANNEXURE I

INSTITUTIONAL ETHICAL COMMITTEE

KSR INSTITUTE OF DENTAL SCIENCE & RESEARCH

KSR Kalvi Nagar, Tiruchengode-637 215, Tamilnadu.
Phone : 04288-274981, Fax : 04288-274761,
email : ksrdentalcollege@yahoo.com

Ref.: 123 /KSRIDSR/EC/2015 **Date : 19.12.2015**

To

Dr.J.Balaji,
Postgraduate Student,
Dept. of Orthodontics,
KSR Institute of Dental Science & Research,

*****

Your dissertational study titled "EFFECT OF FLUORIDE RELEASE BY BONDING AGENT AND VARNISH IN PREVENTION OF ENAMEL DECALCIFICATION DURING ORTHODONTIC TREATMENT – A COMPARAITIVE STUDY" presented before the ethical committee on 15th Dec. 2015 has been discussed by the committee members and has been approved.

You are requested to adhere to the ICMR guidelines on Biomedical Research and follow good clinical practice. You are requested to inform the progress of work from time to time and submit a final report on the completion of study.

Signature of Member Secretary
(Dr.G.S.Kumar)

ANNEXURE II

URKUND

Urkund Analysis Result

Analysed Document:	final plagirism checking.docx (D34901152)
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Submitted By:	drbalajijagan@gmail.com
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Abdulraheem Salem.doc (D33741305)
3.review of literature.docx (D34109279)
EFFECTIVENESS OF NANOHYDROXYAPATITE DENTRIFICE AND FLUORIDATED DENTRIFICE ON ENAMEL SURFACE ROUGHNESS AFTER ORTHODONTIC DEBONDING.docx (D34282389)
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Instances where selected sources appear:

20

ANNEXURE *III*

This is to certify that this dissertation work titled "**EFFECT OF FLUORIDE RELEASE BY BONDING AGENT AND VARNISH IN PREVENTION OF ENAMEL DECALCIFICATION DURING ORTHODONTIC TREATMENT – A COMPARITIVE STUDY"** of the candidate **Dr.Balaji J** with registration number **241519251** for the award of "**Master of Dental Surgery"** in the branch of **Orthodontics and Dentofacial Orthopedics**. I personally verified the urkund.com website for the purpose of plagiarism Check. I found that the uploaded thesis file contains from introduction to conclusion pages and result shows **4%** percentage of plagiarism in the dissertation.

Guide & Supervisor sign with Seal.

ANNEXURE IV

K.S.R Institute of Dental Science and Research
Tiruchengode -637215

CONSENT FORM

TITLE:

EFFECT OF FLUORIDE RELEASE BY BONDING AGENT AND VARNISH IN PREVENTION OF ENAMEL DECALCIFICATION DURING ORTHODONTIC TREATMENT – A COMPARITIVE STUDY

UNDERTAKING BY THE INVESTIGATOR:

Your consent for the above study is sought. We undertake to maintain complete confidentiality regarding the information obtained from you during the study. If you have any doubts regarding the study, please feel free to clarify the same. The investigator and contact number is given below:

Dr.J.Balaji, Mob no- 9159016233.

PARENT'S CONSENT

I _____, P/O, _____, residing at _____

_____do hereby solemnly state as follows.

I am the respondent herein; as such I am aware of the facts stated here under.

I was informed and explained about the pros and cons of the study and the health education provided to my son/daughter in the _____ language known to me.

I give my consent after knowing the full consequences of the study.

I have given voluntary consent for including my child in the study without any individual pressure or duress.

I have also been informed about the purpose and procedures of the study that is to be conducted on my Son/Daughter. I understand that if I give my consent for the study, I will have to provide the necessary details required for the study and co-operate.

I _____ give my consent for my son/daughter to be a part of this investigation.

Signature of the investigator.Signature of the Parent.

Date:

Place: Signature of the Witness.

K.S.R பல் மருத்துவக் கல்லூரி மற்றும் ஆராய்ச்சி மையம்

திருச்செங்கோடு -637215

ஆய்வாளர்: Dr. J.Balaji துறை தலைவர்:
தலைப்பு:

EFFECT OF FLUORIDE RELEASE BY BONDING AGENT AND VARNISH IN PREVENTION OF ENAMEL DECALCIFICATION DURING ORTHODONTIC TREATMENT – A COMPARITIVE STUDY

<u>ஒப்புதல்படிவம்</u>

பெயர் :
முகவரி:
இனம்: ஆண்/பெண்
வயது :வருடம்.

இந்த ஆராய்ச்சியில் என் மகன்/மகள் பங்கெடுப்பதற்க்கு ஒப்புதல் அளிக்கிறேன். மேலும் கீழே கொடுக்கப்பட்டுள்ளவைகளுக்கும் ஒப்புதல் அளிக்கிறேன்.

1. எனக்கு இந்த ஆராய்ச்சி பற்றியதான முழுதகவலும் அளிக்கப்பட்டுள்ளது.
2. இந்த ஆராய்ச்சியில் கேட்கபட உள்ள கேள்விகள் என்மகன்/மகள் சுயம்சார்ந்ததாக இருக்கலாம் என்பது எனக்கு அறிவிக்கப்பட்டுள்ளது.
3. இந்த ஆராய்ச்சியில் செய்யப்படும் பறிசோதனைகளுக்கு முழு ஒத்துழைப்பு அளிப்பேன்.
4. என் மகன்/மகள் பற்றிய விபரங்களை, பறிசோதனை செய்யும் மருத்துவரோ, மருத்துவமனையோ வெளியிடாது என்பது அறிவிக்கப்பட்டுள்ளது.

5. இந்த ஆராய்ச்சியில் இருந்து என் மகனை/மகளை, நானோ அல்லது மருத்துவரோ எப்பொழுது வேண்டுமானாலும் விடுவித்துக்கொள்ளலாம் என்பதும் அறிவிக்கப்பட்டுள்ளது.

பெயர்:கையொப்பம்/ கைவிரல்ரேகை

தேதி :

ஆய்வாளர்: தேதி: